

Case Studies of Navigation Channel and Port Sedimentation



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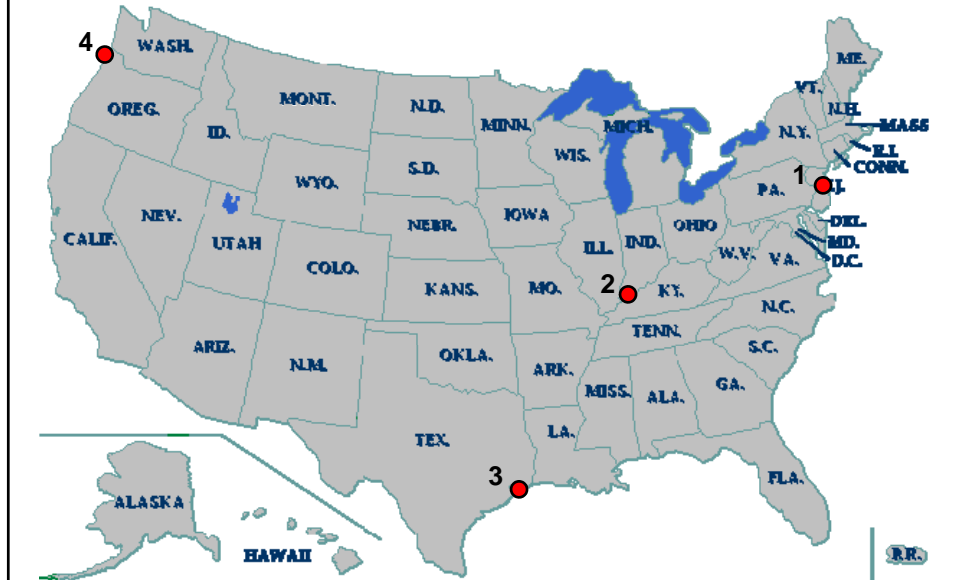
Overview

- Orientation to Examples
- Case Studies
 - Shark River Inlet, NJ
 - Wabash at Ohio River, IN/IL
 - Houston-Galveston Navigation Channel, TX
 - Mouth of Columbia River, WA/OR
- Navigation channels as infrastructure
- Summary

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Case Studies Discussed

1. Shark River Inlet, NJ
2. Breach at Wabash/Ohio R., IN/IL
3. Houston-Galveston Nav Channel, TX
4. Mouth of Columbia River, WA/OR



Shark River Inlet, NJ

Curved jetties built by State of NJ in 1915; straightened in 1948-51. Federal Nav Channel.

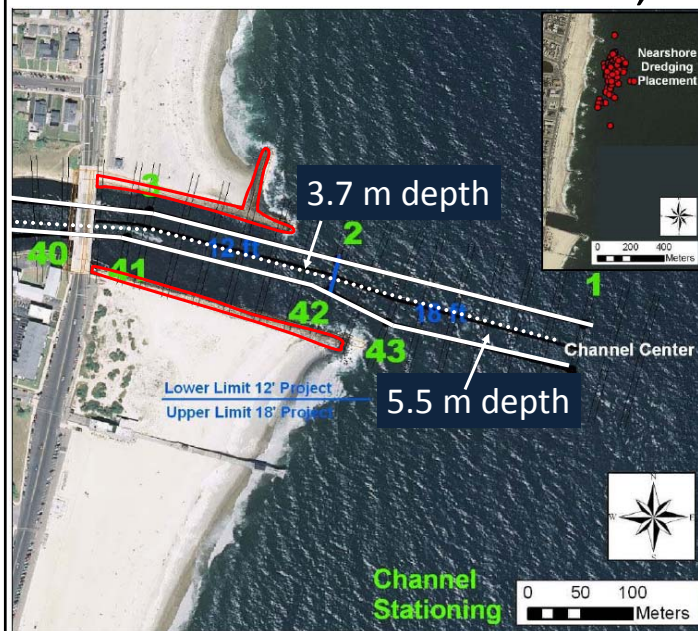


Kraus and Allison, 2009; Beck and Kraus, 2010. <http://cirp.usace.army.mil/pubs/techreports.html>

Shark River Inlet, NJ: Looking West

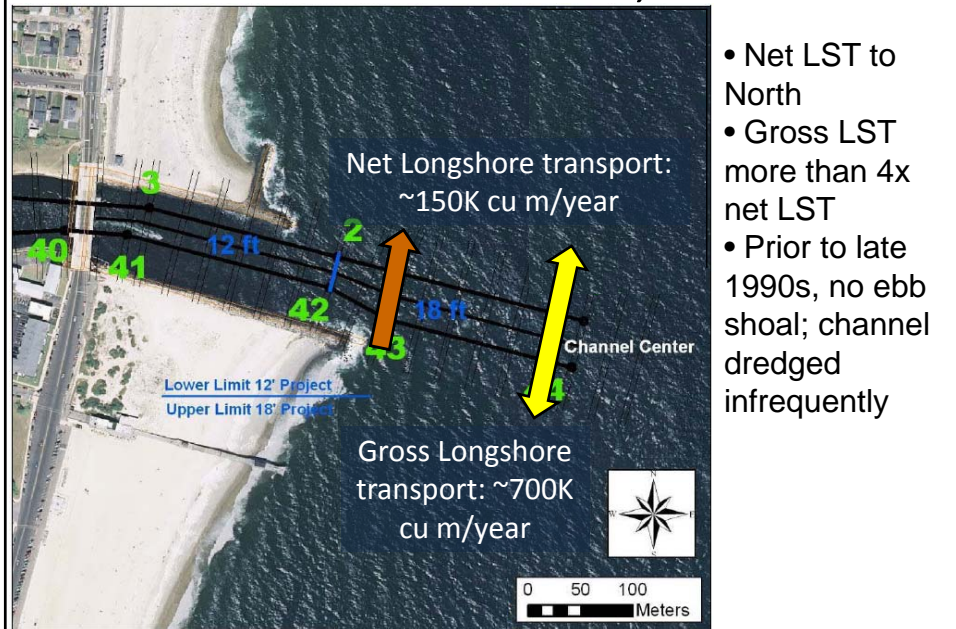


Shark River Inlet, NJ

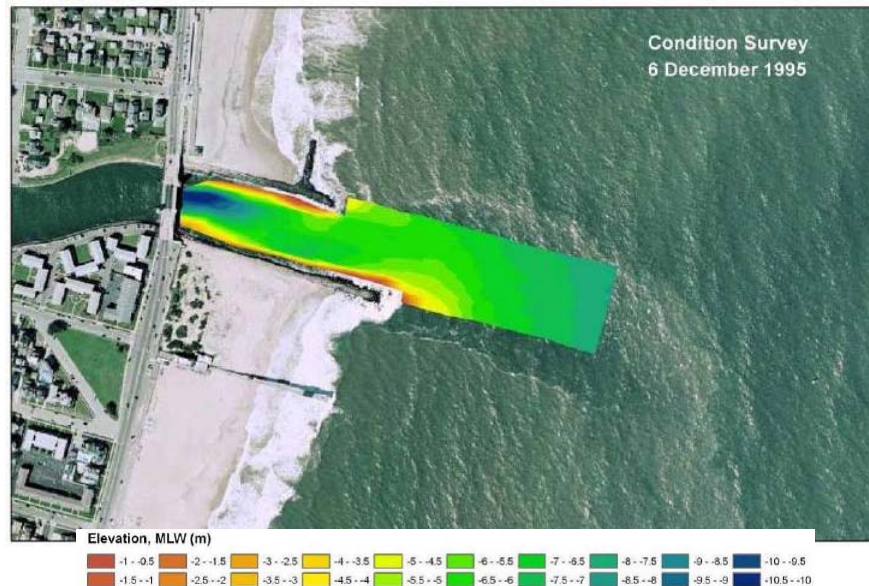


- Shallow-draft, high-use channel
- Unequal length jetties
- Spur on north jetty

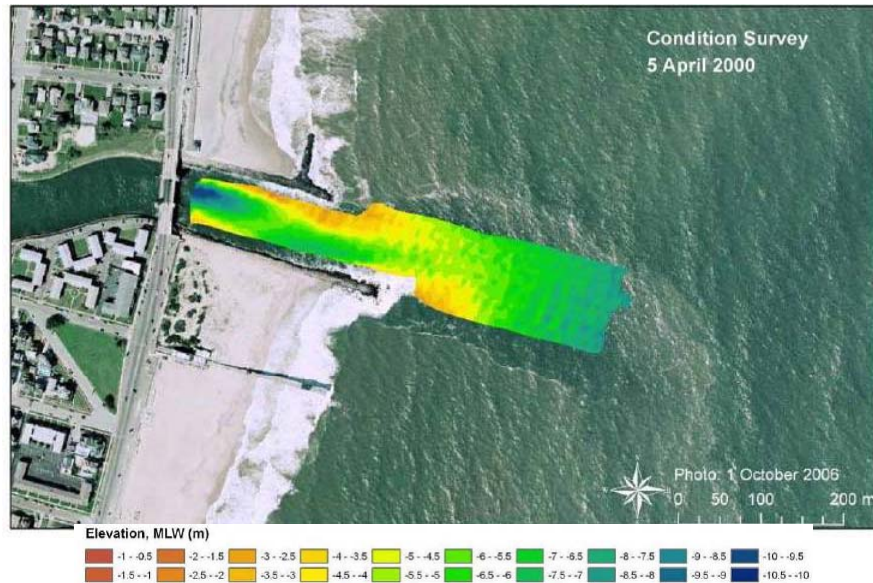
Shark River Inlet, NJ



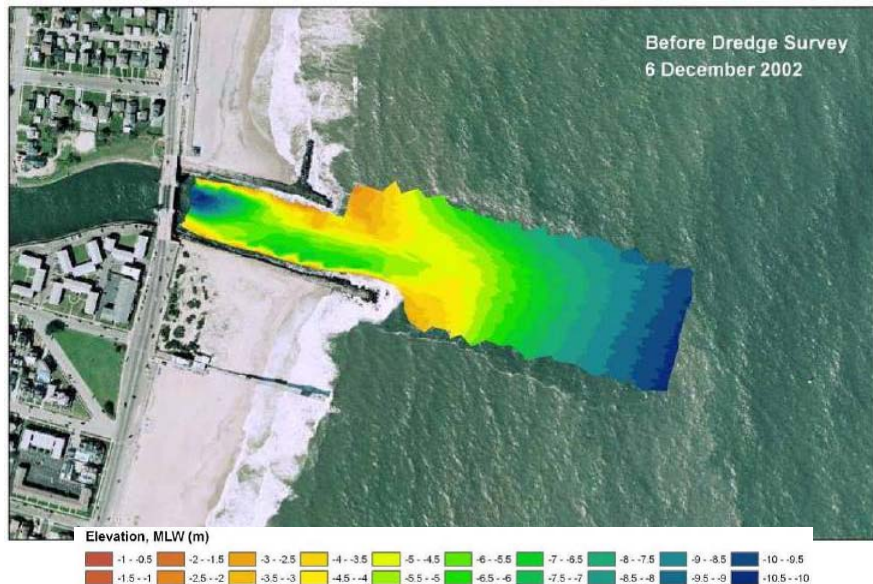
Shark River Inlet, NJ: Dec 1995



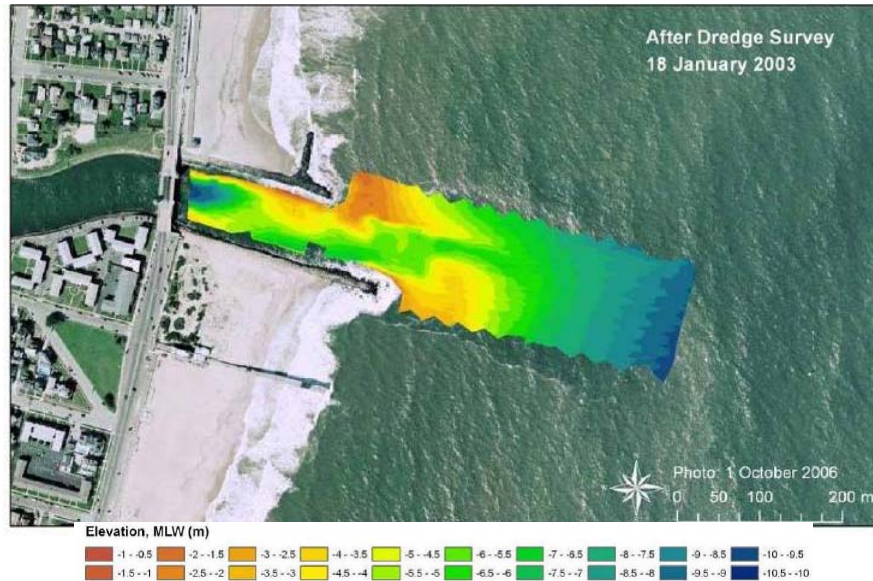
Shark River Inlet, NJ: Apr 2000



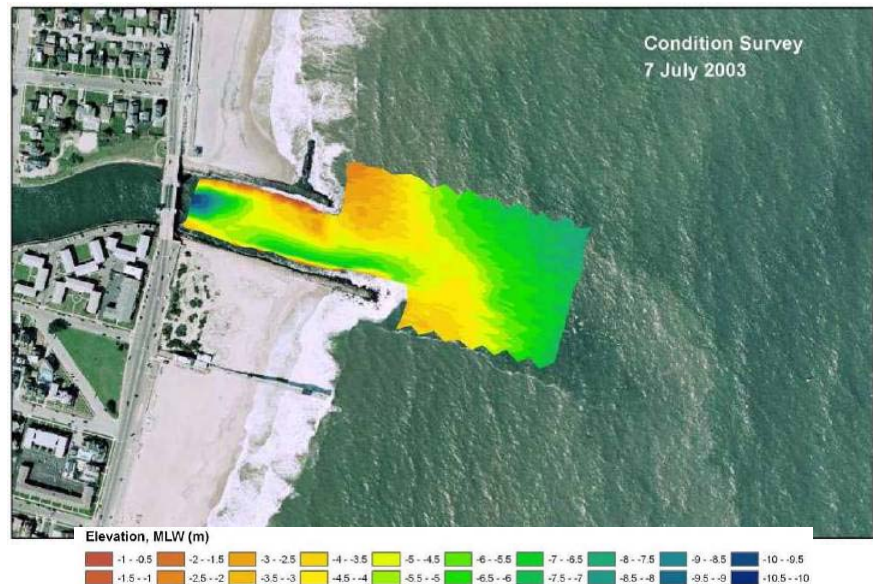
Shark River Inlet, NJ: Dec 2002



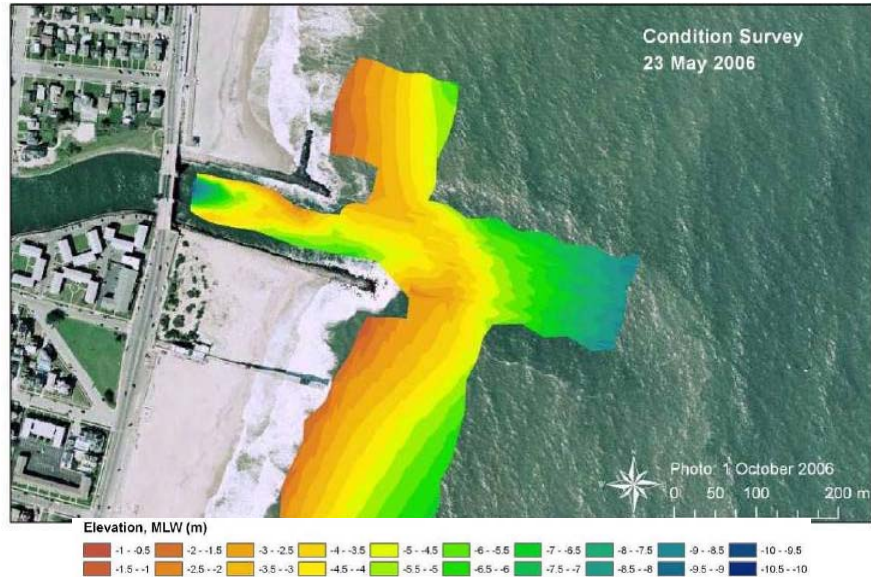
Shark River Inlet, NJ: Jan 2003



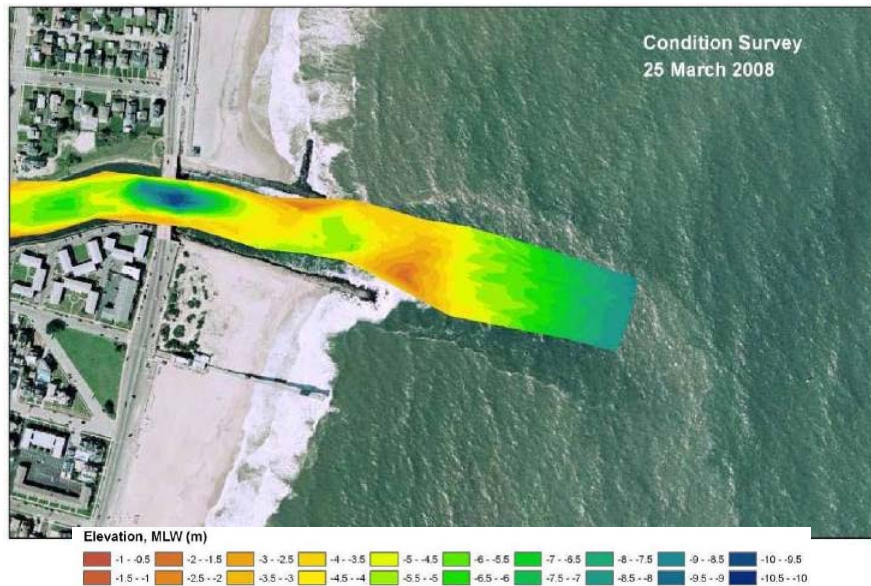
Shark River Inlet, NJ: Jul 2003



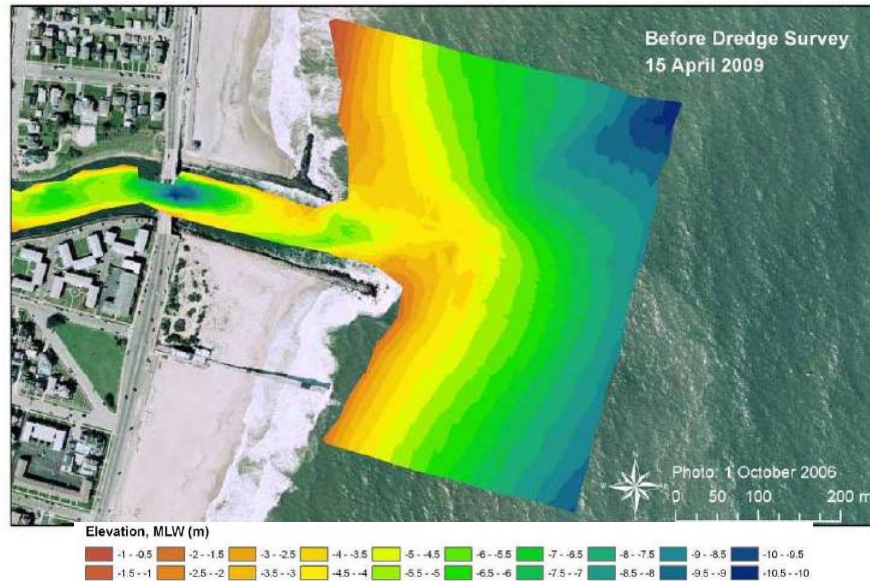
Shark River Inlet, NJ: May 2006



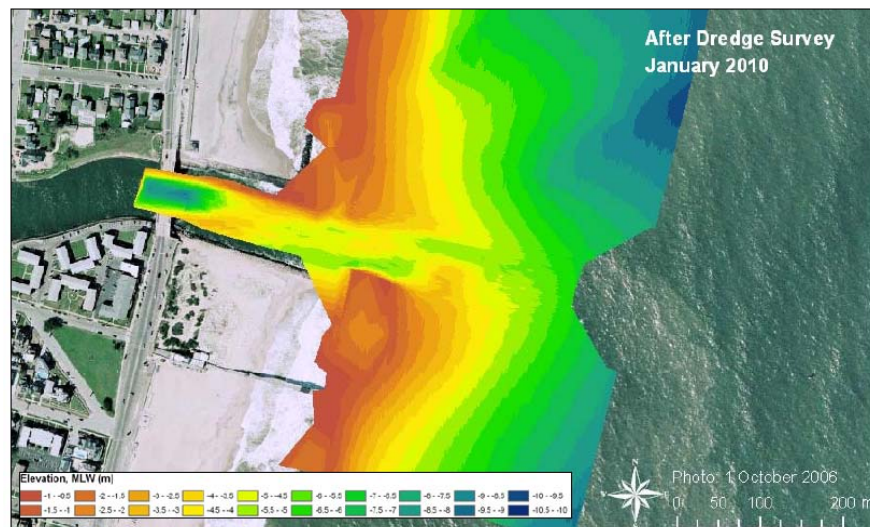
Shark River Inlet, NJ: Mar 2008

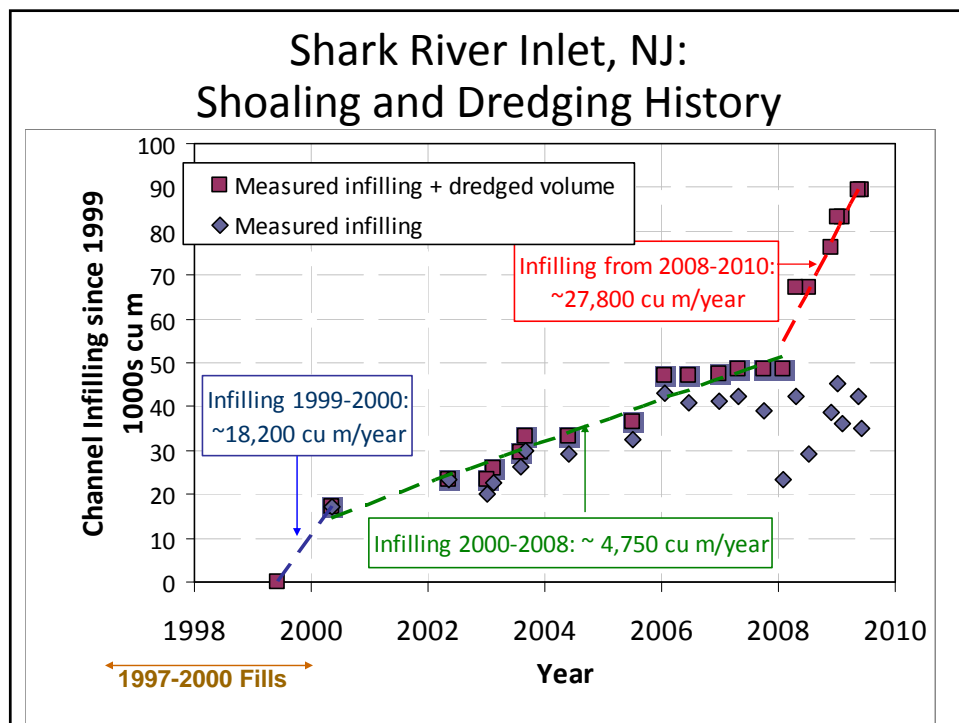
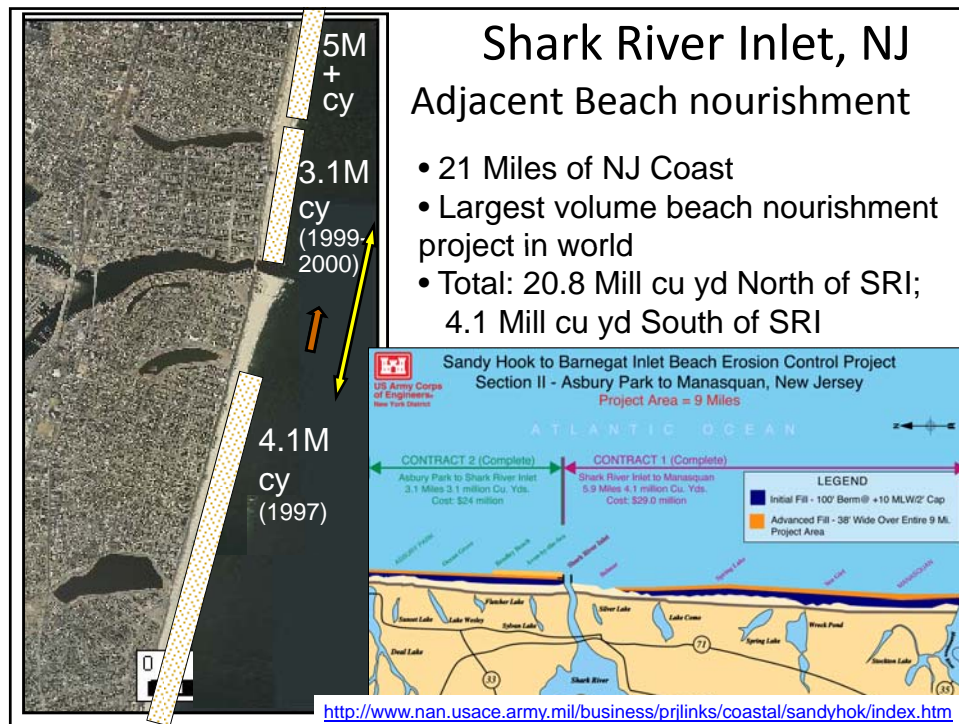


Shark River Inlet, NJ: Apr 2009

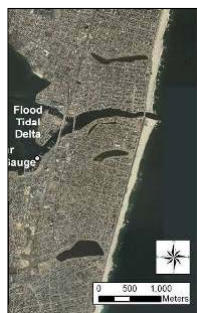


Shark River Inlet, NJ: Jan 2010





Shark River Inlet, NJ: Summary

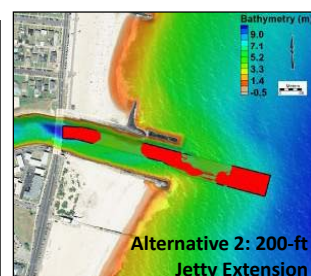
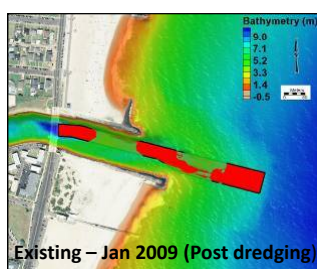
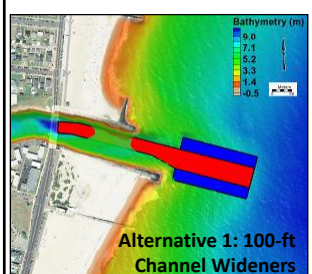


Problem: unprecedented channel shoaling following fill on adjacent beaches

Questions: (1) Why has SRI begun shoaling after decades of no to low maintenance?

(2) What are short-term solutions to extending the dredging interval (every 3 mos in 2010!)

(3) What are long-term solutions?



Breach at Wabash on Ohio River, IN/IL



Breach at Wabash on Ohio River, IN/IL



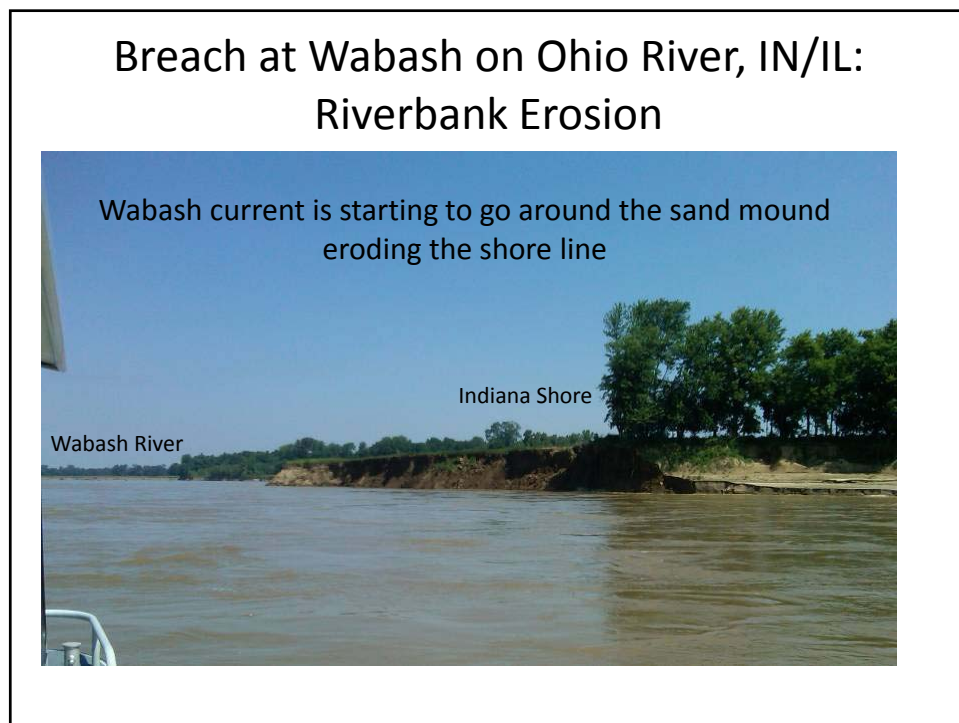
Slides Courtesy Barry Vessel, USACE Louisville District

Breach at Wabash on Ohio River, IN/IL:

Two breaches increase sedimentation in Ohio River

Note: looking south



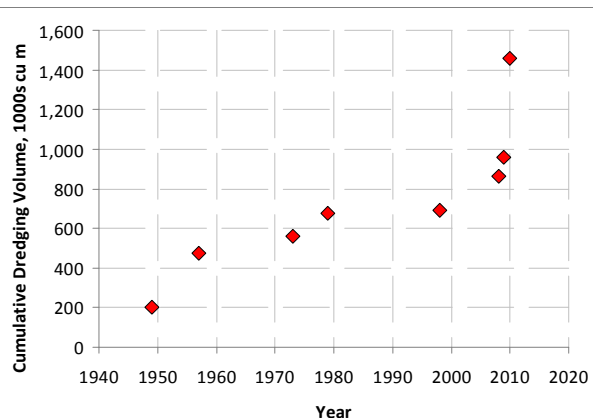


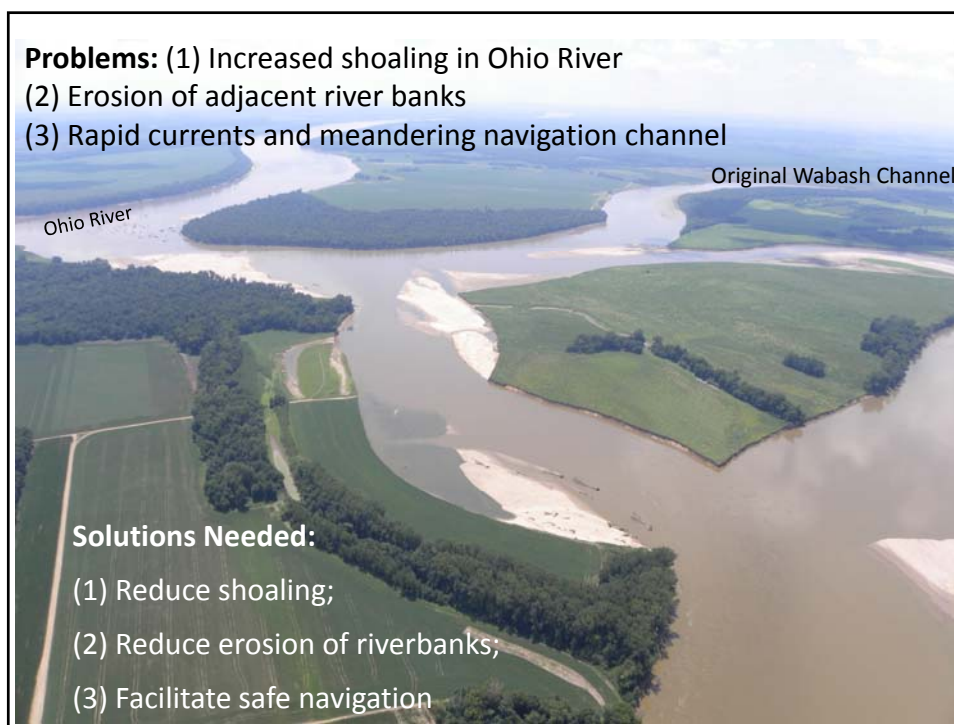
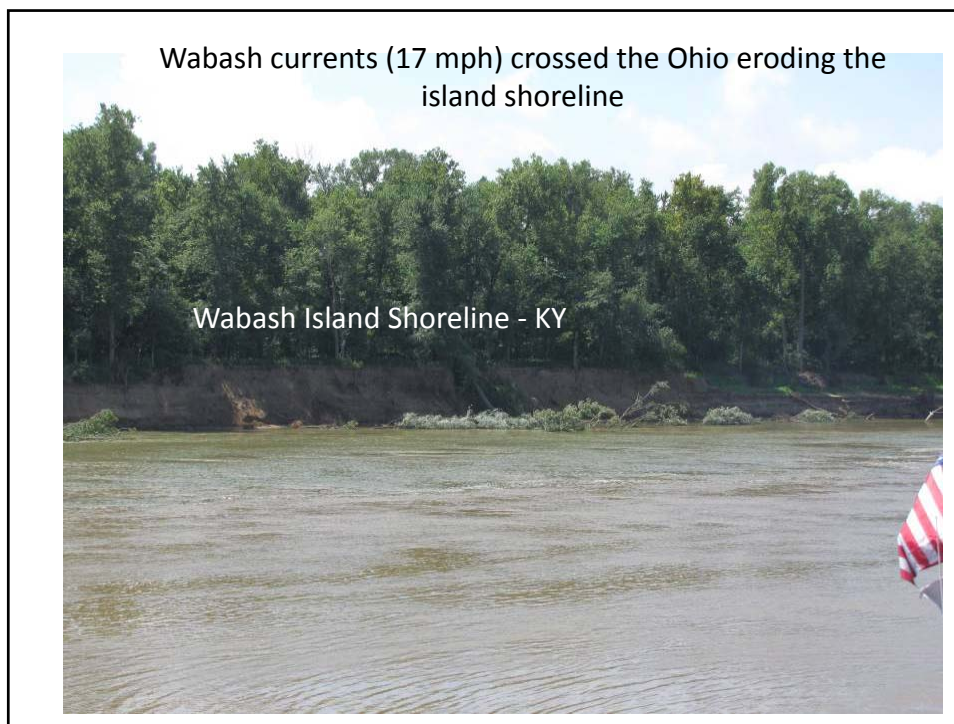
Breach at Wabash on Ohio River, IN/IL



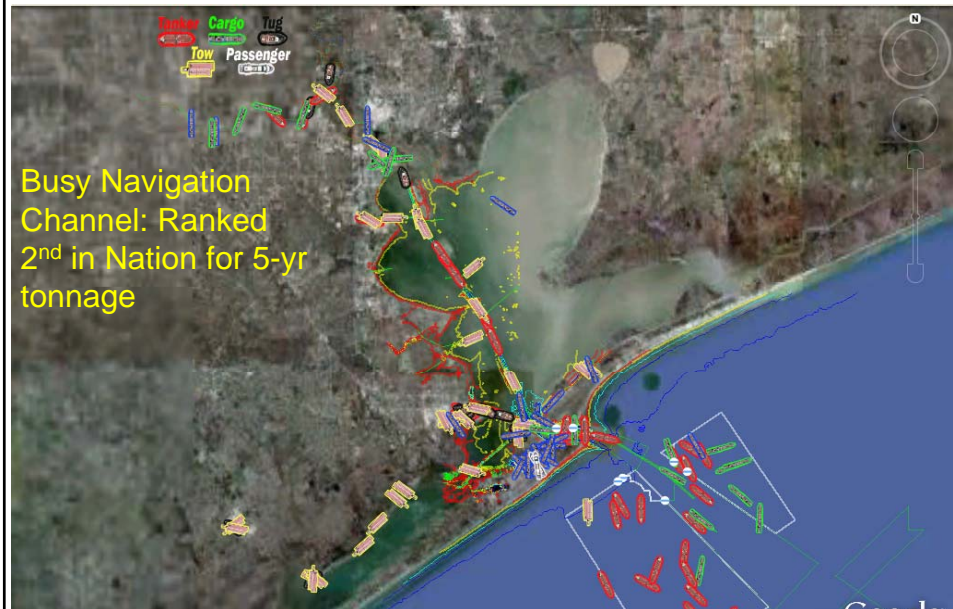
Breach at Wabash on Ohio River, IN/IL: Dredging

Mouth of Wabash - Dredging	
Year	Cu Yards
1949	199,604
1957	276,754
1973	81,665
1979	116,891
1998	16,691
2008	173,964
2009	93,633
2010	500,000+

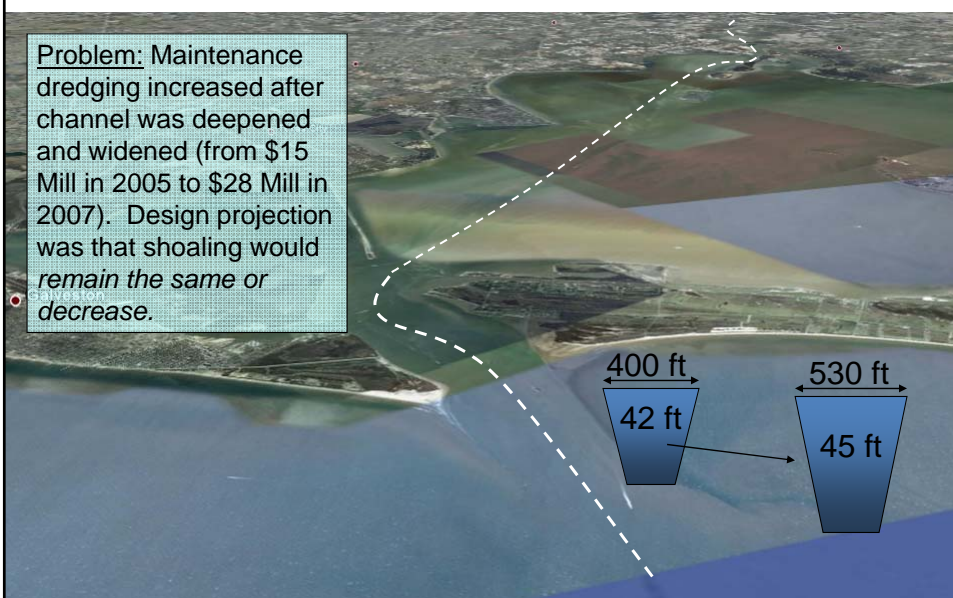




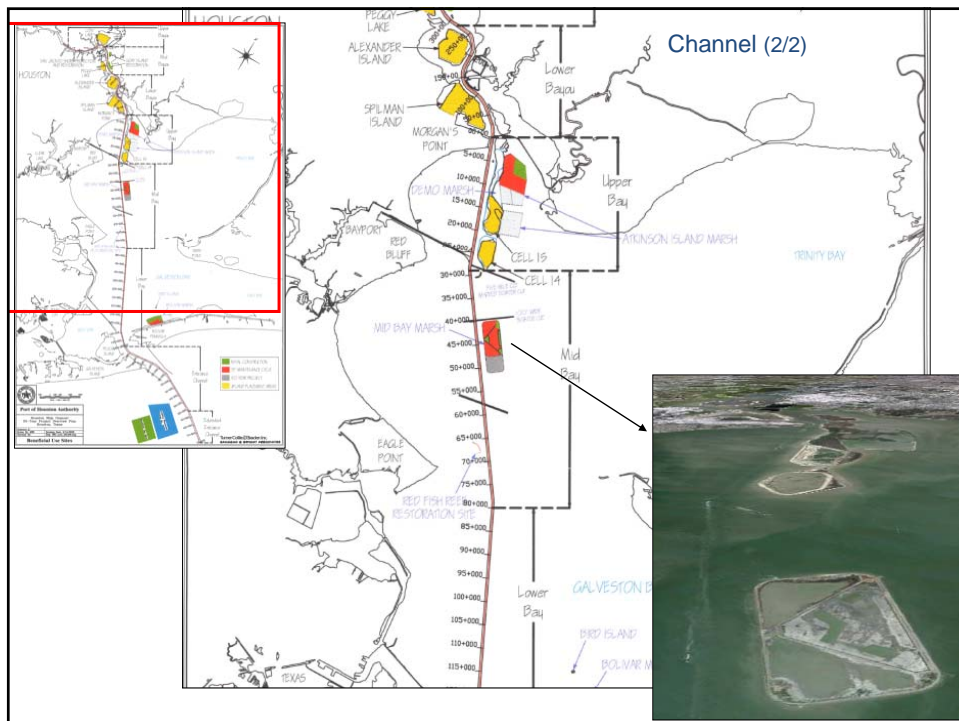
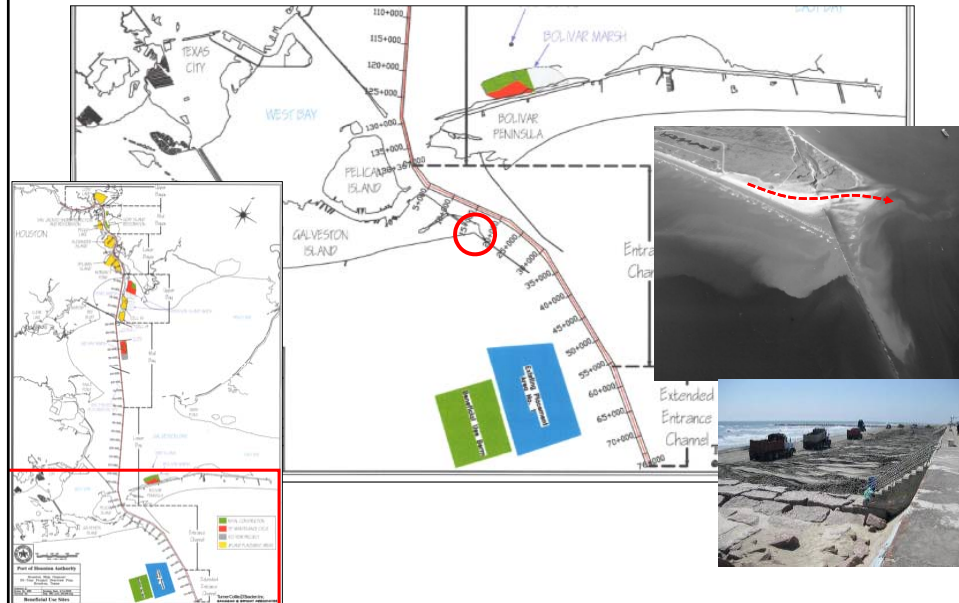
Houston-Galveston Navigation Channel, TX

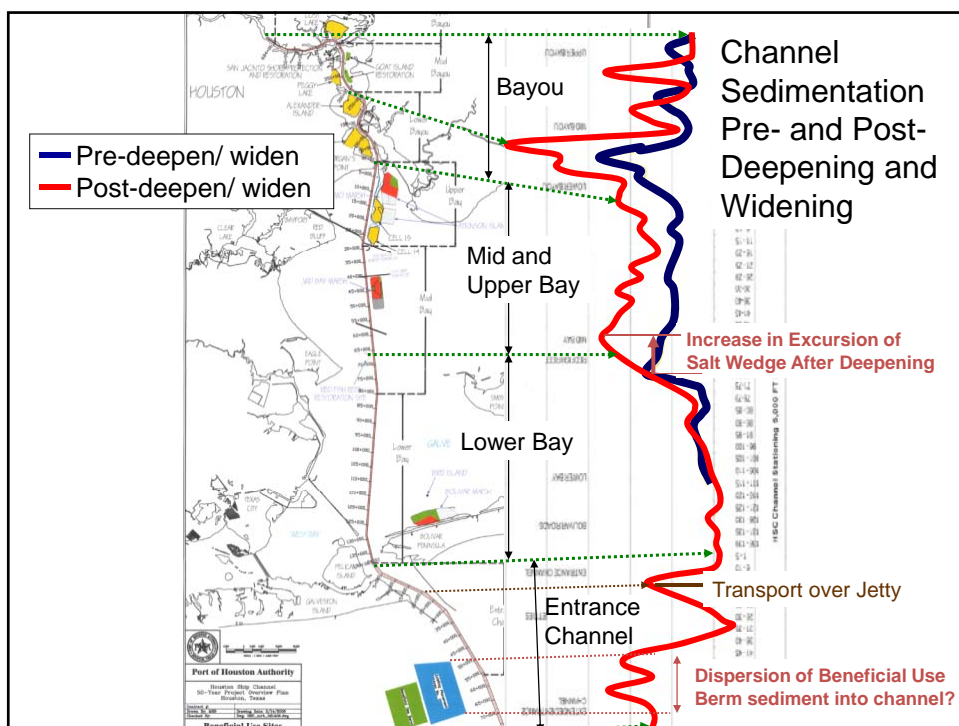


Houston-Galveston Ship Channel Problem Statement

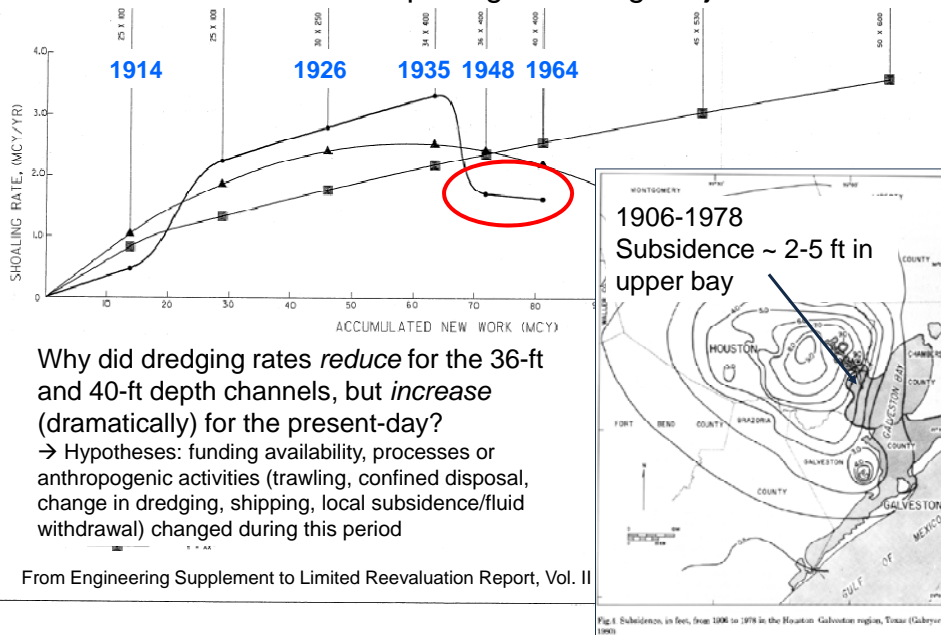


Overview of Channel (1/2)





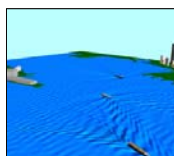
Project Justification based (in part) on Decreasing Shoaling Rates in Previous Deepening/Widening Projects



MCNP Hypotheses

Why is channel shoaling more than anticipated? (1 of 2)

1. Beneficial Use Site is being dispersed into Entrance Channel (EC).
2. Sand is being transported over/through jetties into EC.
3. HGNC is flood dominated and sediment moves up channel and into bay.
4. More vessels are moving faster than in pre-deepening/widening era, which mobilizes more sediment.
 - a. Induces sediment deposition in channel.
 - b. Ship wake erodes bay shorelines and disposal sites.
5. Confluence of tidal and vessel currents at channel intersections induce shoaling.



MCNP Hypotheses

Why is channel shoaling more than anticipated? (2 of 2)

6. Salt wedge has intruded further into bay since deepening/widening.
7. Anthropogenic activities have modified shoaling patterns and magnitudes (trawling, dredging and disposal, subsidence/fluid withdrawal).
8. Placement sites have changed river flow patterns, which induces deposition into the channel west of Atkinson Island.
9. Fluid mud forms in the spring during high river flow and a decrease in salinity in Gulf*.
 - a. FM forms in shallow water.
 - b. FM flows towards the channel with passage of vessels.
 - c. FM flows down slope into deeper parts of the channel.

* Salinity decreases in Gulf in the Spring because of increased freshwater flow from Mississippi and Atchafalaya Rivers.

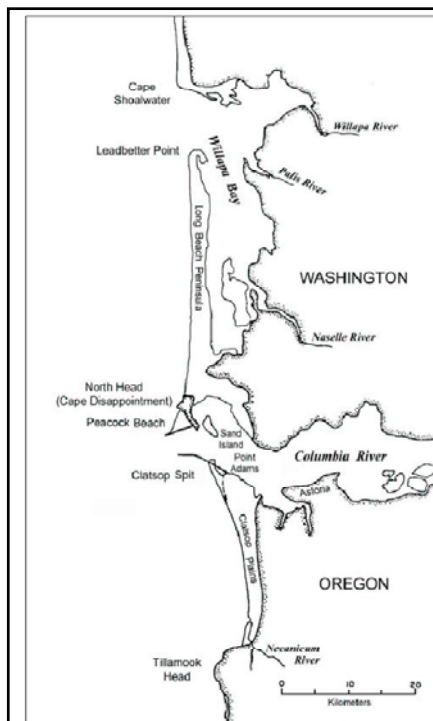


Houston-Galveston Ship Channel Summary

Problems: (1) Methods to estimate infilling with channel improvements not sufficient. What processes are missing?
 (2) Placement sites 20-year capacity exceeded in 5 years. Where to place dredged sediments at reasonable cost?
 (3) Adjacent beach erosion; Need to foster a regional sediment management approach.

Solutions Needed:

- (1) Reduce shoaling.
- (2) Develop additional placement sites.
- (3) Keep sand in littoral system.

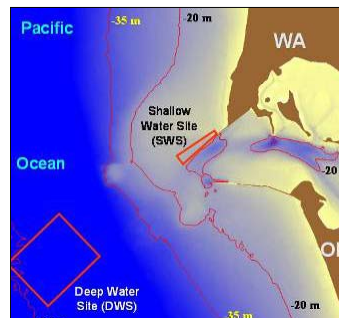


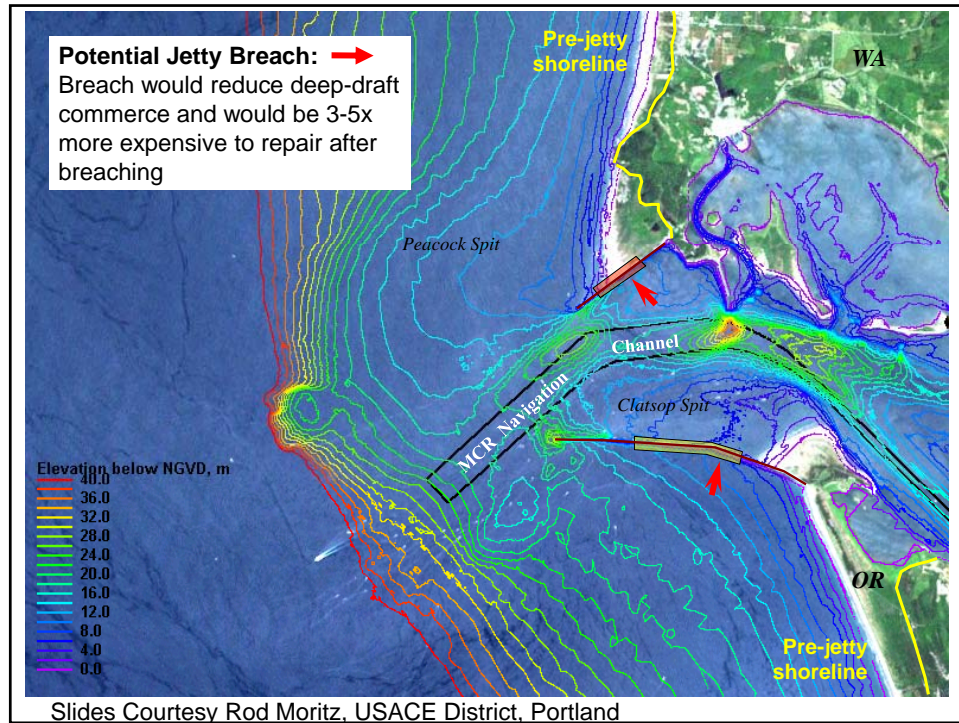
Jetties at Mouth of Columbia River, WA/OR

Annual Dredging: 3-4 Mill cu m

Problem:

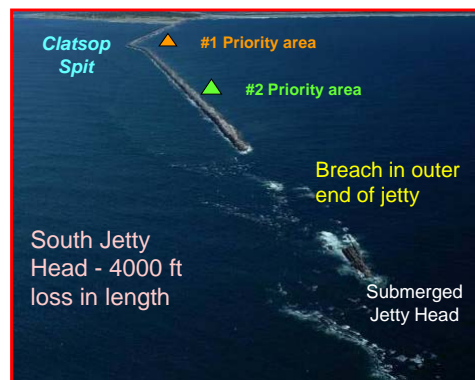
- Jetties were built in 1895-1915 on ebb shoal platform
- Ebb shoal has evolved in past 100 yrs
- Jetties are damaged
- When is rehabilitation necessary?



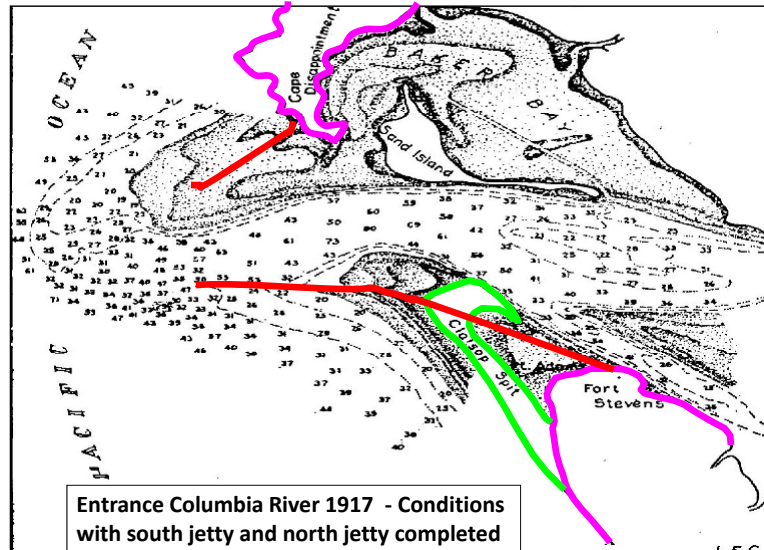


Jetties at Mouth of Columbia River, WA/OR

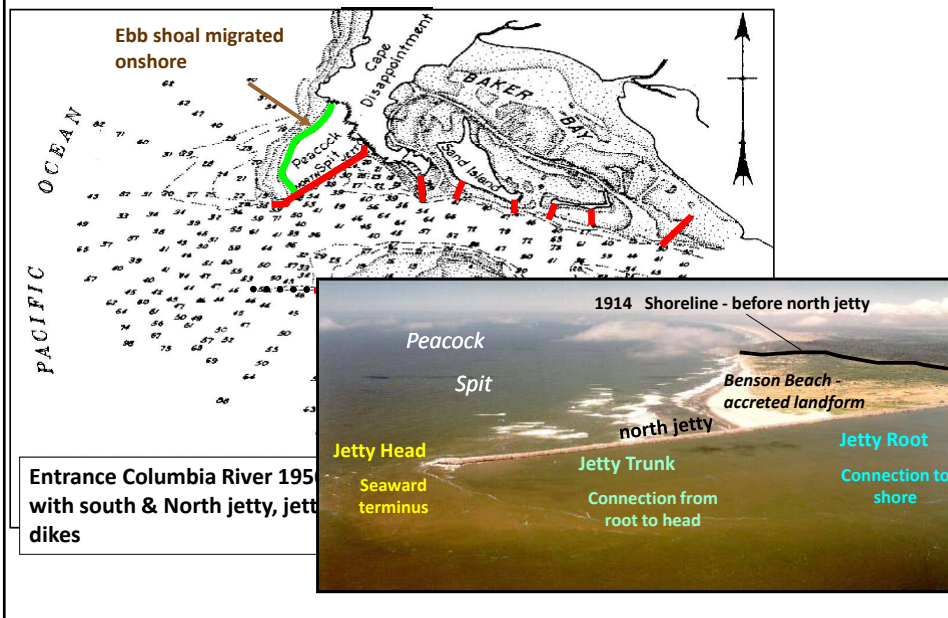
South Jetty



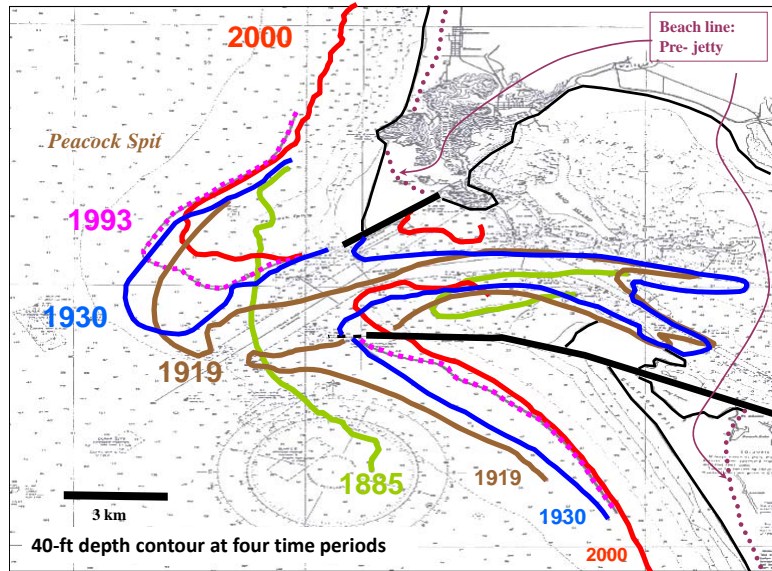
MCR Jetties: 1917 Bathymetry



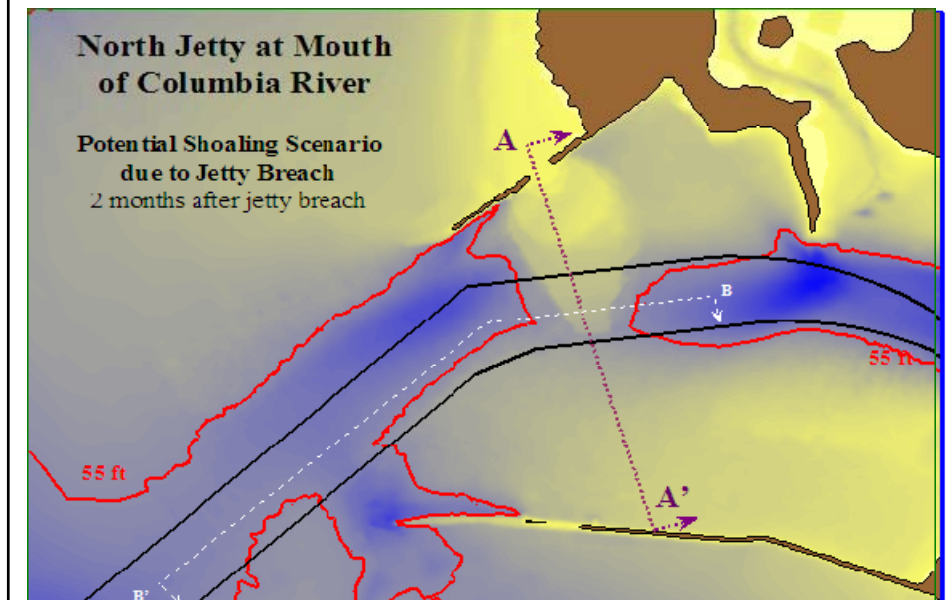
MCR Jetties: 1950 Bathymetry



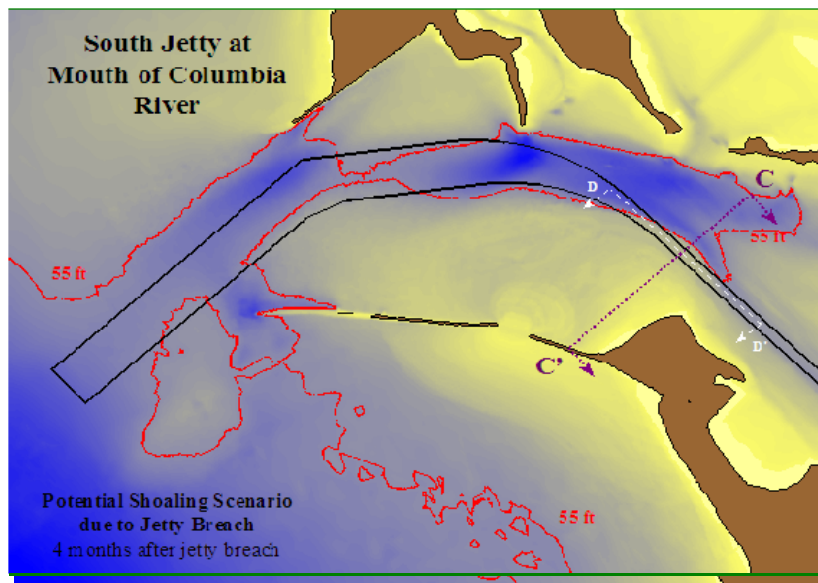
MCR Jetties: 40-ft depth contour



MCR: Potential North Jetty Breach



MCR: Potential South Jetty Breach



MCR: Summary

Problems:

- (1) Aging jetties are losing ebb shoal foundation on which they were constructed.
- (2) Jetties have been damaged and breached in locations.

Solutions Needed:

- (1) Should jetties be rehabilitated? If so, when?
- (2) Where should dredged sand be placed to nourish adjacent beaches and the jetty foundation?



- Navigation channels are an *invisible* part of an integrated system with many aspects:
 - *Jetties, adjacent beaches, dredging, placement sites, potential for environmental enhancement and degradation, safe navigation!*
 - Many navigation projects are decades to centuries old
 - *Integrated system has changed in past 50-100+ years, both regional/natural (sea level change) and local/anthropogenic (dredge material practices)*
 - Funding availability will reduce number of channels that can be maintained in future
 - Opportunity to anticipate future changes and mitigate for these proactively
- 